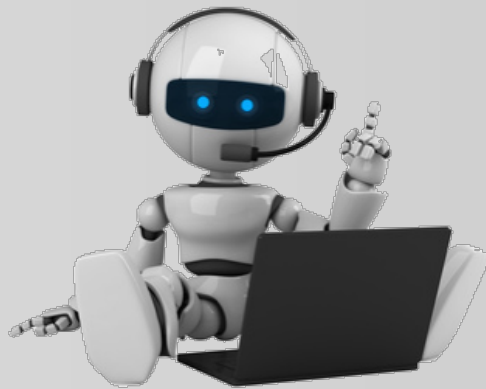


# Instructional design and natural language processing in **dialogue-based CALL**



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Thomas François  
Piet Desmet

CALICO Conference  
May 11, 2016

**KU LEUVEN**



**UCL**  
Université  
catholique  
de Louvain



# How do we practice **speaking** in a MOOC ?

The screenshot shows the Coursera interface for a course. On the left is a dark sidebar with the Georgia Tech logo and navigation links: Home, Course Content, Assignments, Discussions, and Course Info. The top header includes the Coursera logo, a user profile icon (SB), and a blue banner with a promotional message and an 'Upgrade' button. The main content area features the course title 'Speak English Professionally: In Person, Online & On the Phone' by Georgia Institute of Technology. Below this is a welcome message from Amalia B. Stephens, including a profile picture and text encouraging students to engage with the community and course materials. A vertical 'Help Center' button is on the right edge.

**coursera** SB

Like this course? Become an expert by joining the [Improve Your English Communication Skills Specialization](#). [Upgrade](#)

**Georgia Tech**

Home

Course Content

Assignments

Discussions

Course Info

## Speak English Professionally: In Person, Online & On the Phone

by Georgia Institute of Technology

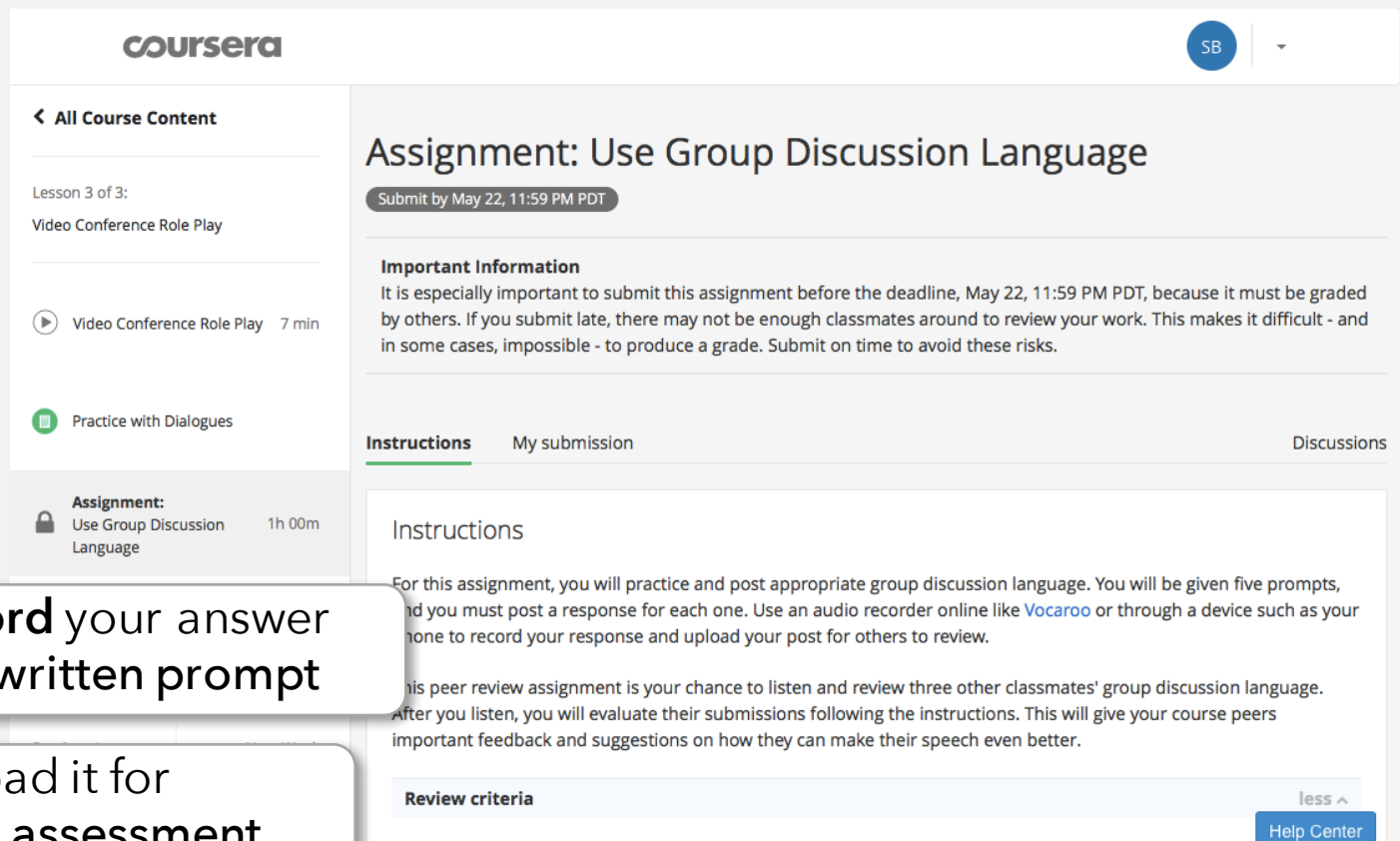
Amalia B. Stephens

Welcome to Speak English Professionally: In Person, Online & On the Phone! You're joining thousands of learners currently enrolled in the course. I'm excited to have you in the class and look forward to your contributions to the learning community.

To begin, I recommend taking a few minutes to explore the course site. Review the material we'll cover each week, and preview the assignments you'll need to complete to pass the course. Click **Discussions** to see forums where you can discuss the course material with fellow students taking the class. Be sure to introduce yourself to everyone in the Meet and Greet forum.

Help Center

# How do we practice **speaking** in a MOOC ?



**coursera**

SB

< All Course Content

Lesson 3 of 3:  
Video Conference Role Play

Video Conference Role Play 7 min

Practice with Dialogues

**Assignment:**  
Use Group Discussion Language 1h 00m

## Assignment: Use Group Discussion Language

Submit by May 22, 11:59 PM PDT

**Important Information**  
It is especially important to submit this assignment before the deadline, May 22, 11:59 PM PDT, because it must be graded by others. If you submit late, there may not be enough classmates around to review your work. This makes it difficult - and in some cases, impossible - to produce a grade. Submit on time to avoid these risks.

**Instructions** My submission Discussions


### Instructions

For this assignment, you will practice and post appropriate group discussion language. You will be given five prompts, and you must post a response for each one. Use an audio recorder online like [Vocaroo](#) or through a device such as your phone to record your response and upload your post for others to review.


This peer review assignment is your chance to listen and review three other classmates' group discussion language. After you listen, you will evaluate their submissions following the instructions. This will give your course peers important feedback and suggestions on how they can make their speech even better.

**Review criteria** less ^

Help Center



**Record** your answer to a written prompt



Upload it for peer assessment

# In many learning environments, learners lack **speaking in interaction**

## Online learning environments

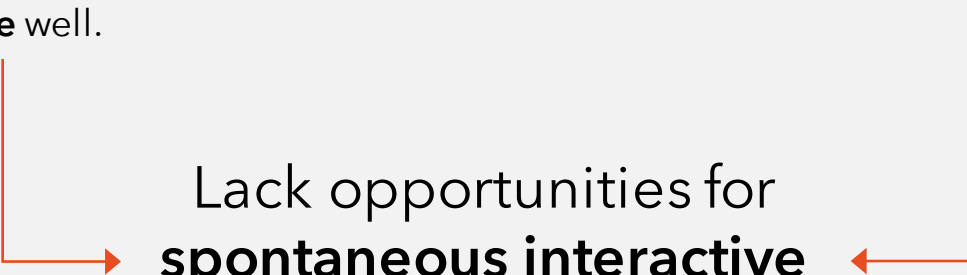
MOOCs, apps & websites for  
autonomous language learning

Synchronous computer-mediated  
communication (**SCMC**)  
– whether **audio**, **video** or **text chat** –  
is difficult to **supervise**  
and does not **scale** well.

## Foreign language instruction contexts

No L2 outside the classroom  
Large classes in developing countries

Limited **teacher-student** interaction  
Very rare **peer** interaction  
No opportunities **outside** the class



Lack opportunities for  
**spontaneous interactive**  
practice of the L2

# Dialogue-based CALL

Dialogue-based CALL refers to  
any application or system allowing

to maintain a **dialogue**

[ immediate, synchronous interaction ]

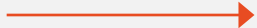
[ written or spoken ]

with an **automated agent**

[ tutorial CALL (≠ CMC) ]

for **language learning** purposes.

# Designing dialogue-based CALL systems to allow for interactive and meaningful practice

Instructional design  Technological approach

Learning outcomes

Task to accomplish

Learning principle

Degree of interactivity

Scaffolding

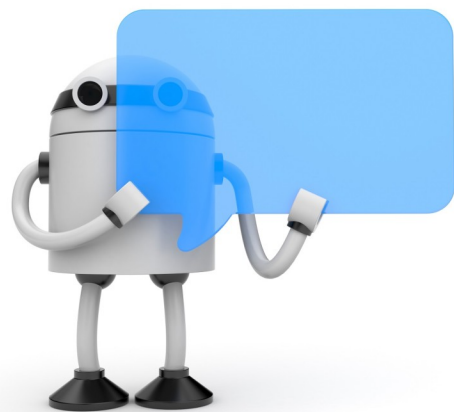
Dialogue modelling

Initiative management

Natural language  
understanding

Adaptivity and  
user modelling

# Instructional design and natural language processing in dialogue-based CALL



## Previous research & existing systems

A research synthesis from 1982 to 2015

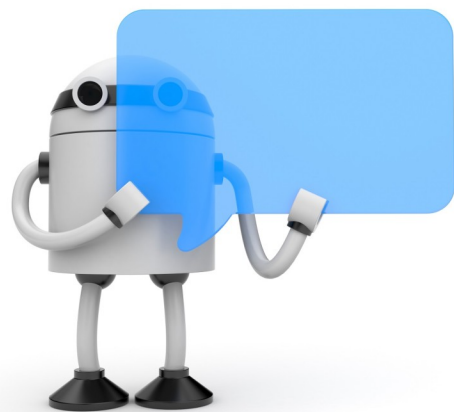
## Instructional design & technological challenges

A typology of dialogue-based CALL systems

## Natural language processing approaches to dialogue systems

From handcrafted rules to machine learning

# Instructional design and natural language processing in dialogue-based CALL



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# Corpus of studies

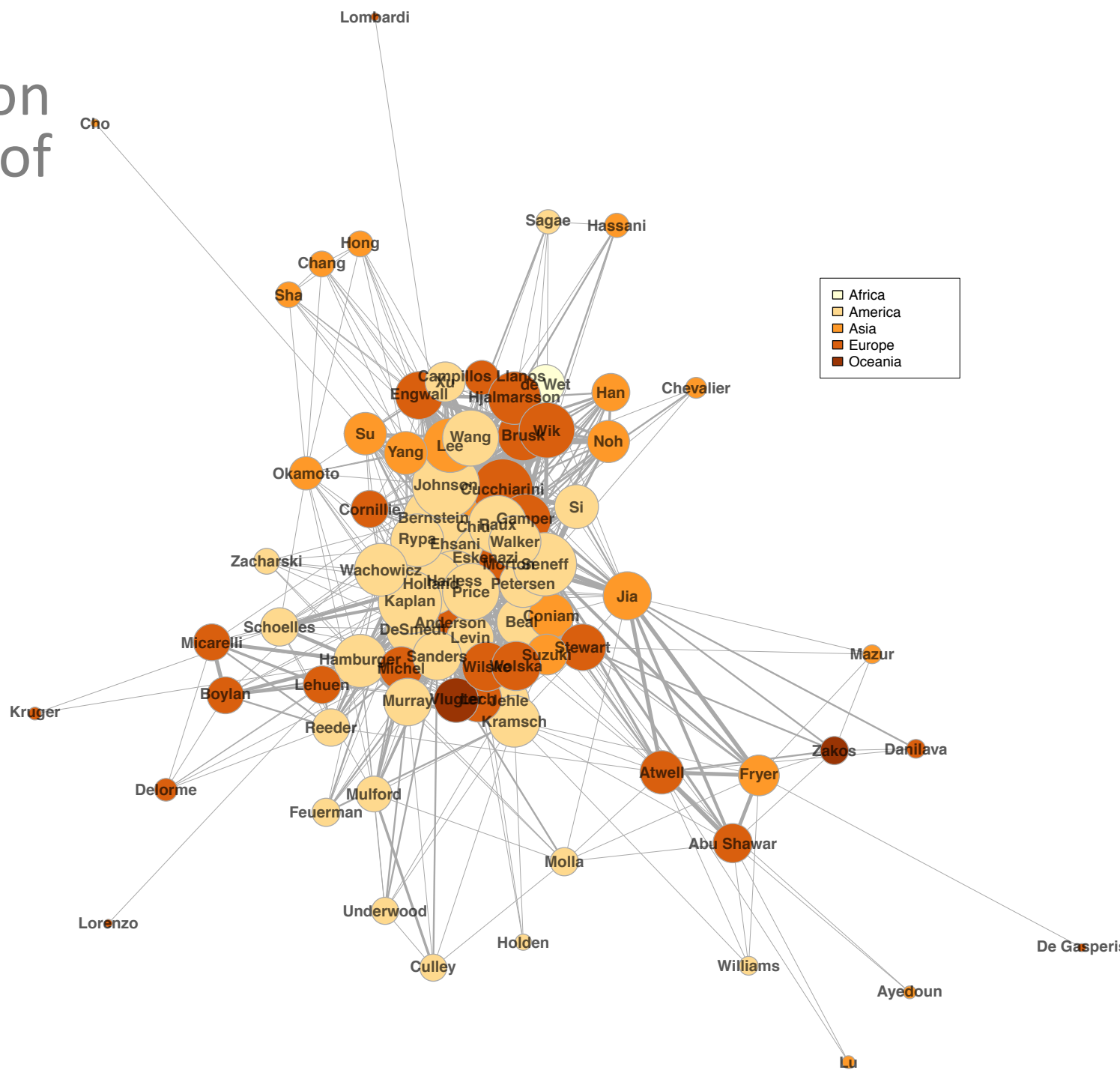
146 papers

80 different systems

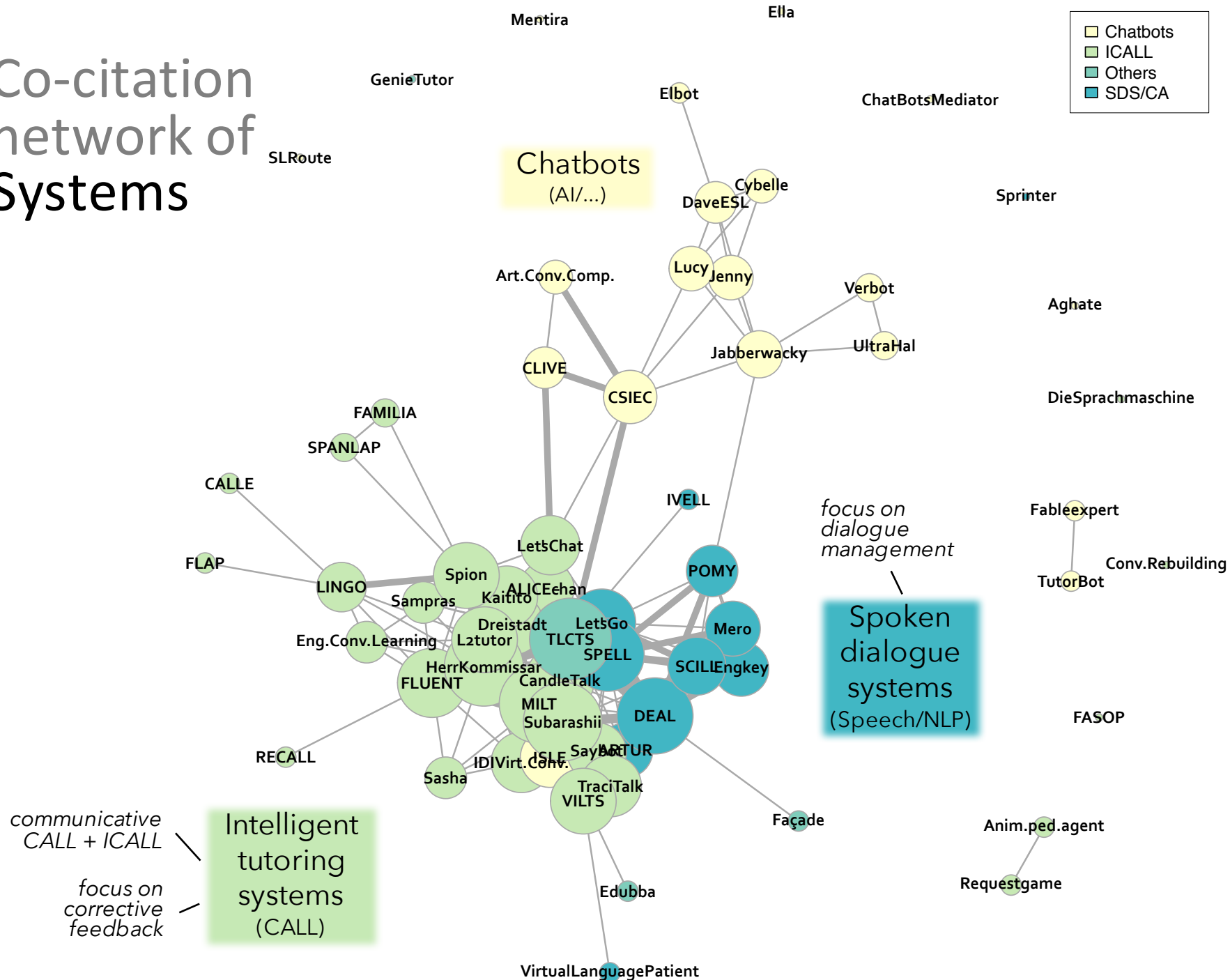
(67 designed for lang. learning)



# Co-citation network of Authors



# Co-citation network of Systems

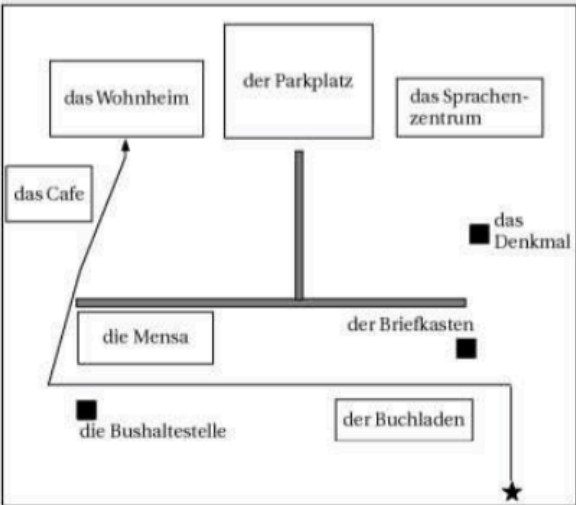


# Intelligent tutoring system

## *Map task* (Wilske, 2014)

DE ENG

**Aufgabe**  
Sie sind auf dem Campus der Uni.  
Jemand fragt Sie nach dem Weg.



**Dialog-Verlauf**  
A: Entschuldigung, können Sie mir sagen, wie ich zu dem Wohnheim komme?

**Feedback**  
den  
✗ Falsch!

**Status**  
Füllen Sie die Lücke mit einem bestimmten Artikel (der, die, das, ...)

**Punkte**  
-1

Gehen Sie zuerst geradeaus bis zu  Buchladen.

Enter

Aufgabe 1 Aufgabe 2 Löschen

# Spoken dialogue system

## SCILL (Seneff et al, 2007)

**system:** Welcome, please enter your username before we get started.  
The conversation history will be maintained here.

Send Input

### Here's your scenario

You want to book a flight from [San Francisco](#) to [Beijing](#). You want to travel on Tue Nov 1, and return on the monday before Nov 15. You prefer [United Airlines](#).

SCORE: 0

Abort Game

Checklist

☐ airline  
☐ destination  
☐ number of flights booked  
☐ departure date  
☐ return date  
☐ source

You are currently at level 3. Hold down the 'Hold to talk' button and talk in Chinese.

[Hide help](#)  
✎ 我想要从旧金山出发  
✎ 从旧金山出发飞北京  
✎ 飞北京

Your Current Itinerary

No flight booked

# Chatbot

## Leslie Linguo

# Leslie Linguo

You:

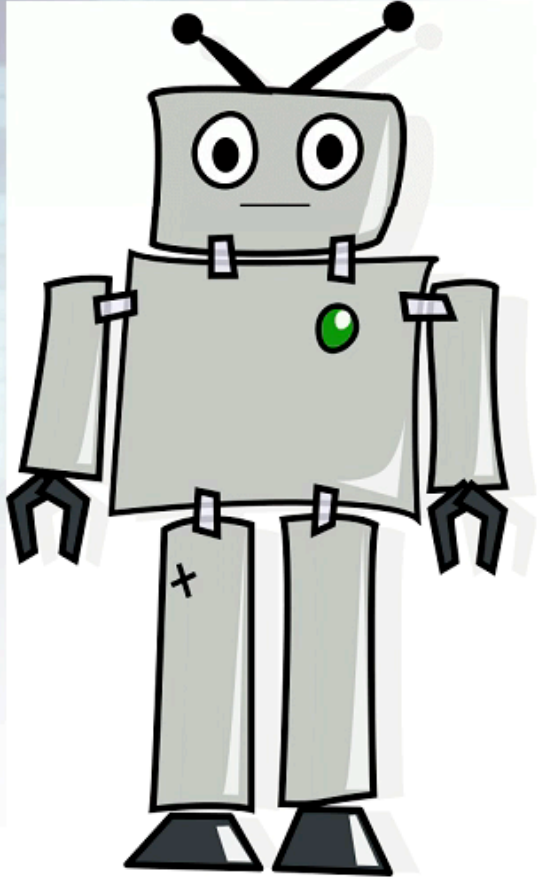
Leslie: Hello, my name is Leslie. I am an ESL oriented chat bot. I can talk about different topics in English, define words, provide synonyms and antonyms, translate my responses into over thirty languages, explain grammar, and finally conjugate nouns, adjectives and verbs, both in writing and orally. What can I do for you today?

SAY

Your input:

Spelling mistakes:

Translation: You must [register](#) to get translations of Leslie's answers into your language. Registration is free and easy. Click [here](#) for more information, or [here](#) to login.

A cartoon robot character with a grey, boxy head and body. It has two antennae with black spheres at the top. Its eyes are large, white circles with black pupils. It has a small, straight line for a mouth. The robot's arms are long and thin, ending in black, three-fingered hands. Its legs are also long and thin, ending in black, flat feet. A small green circular light is visible on its chest. The robot is standing on a light grey surface against a light yellow background.

# Dialogue simulations in a virtual world

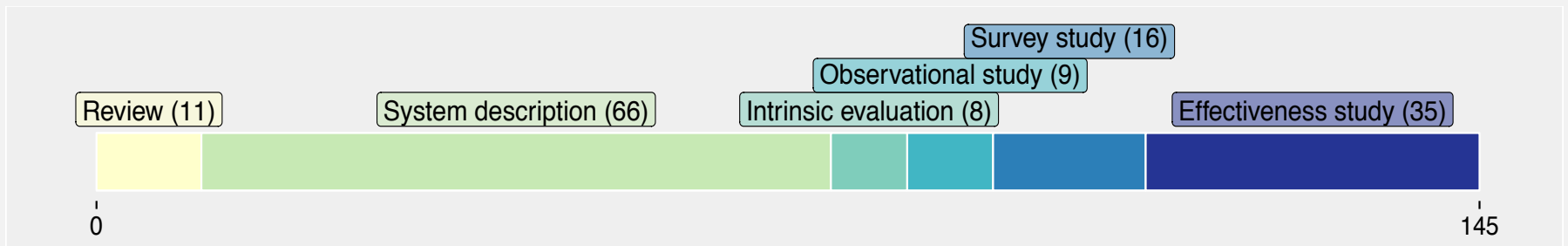
## Tactical Language and Culture Training System (Johnson *et al*, 2005)



# Limitations

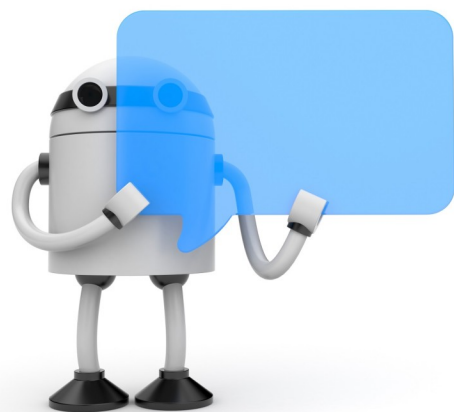
Almost none of the 80 systems studied have made it to the **general public**.

We know very little about their **effectiveness on language learning**.





# Instructional design and natural language processing in dialogue-based CALL



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# Need for an instructional design approach of dialogue-based CALL

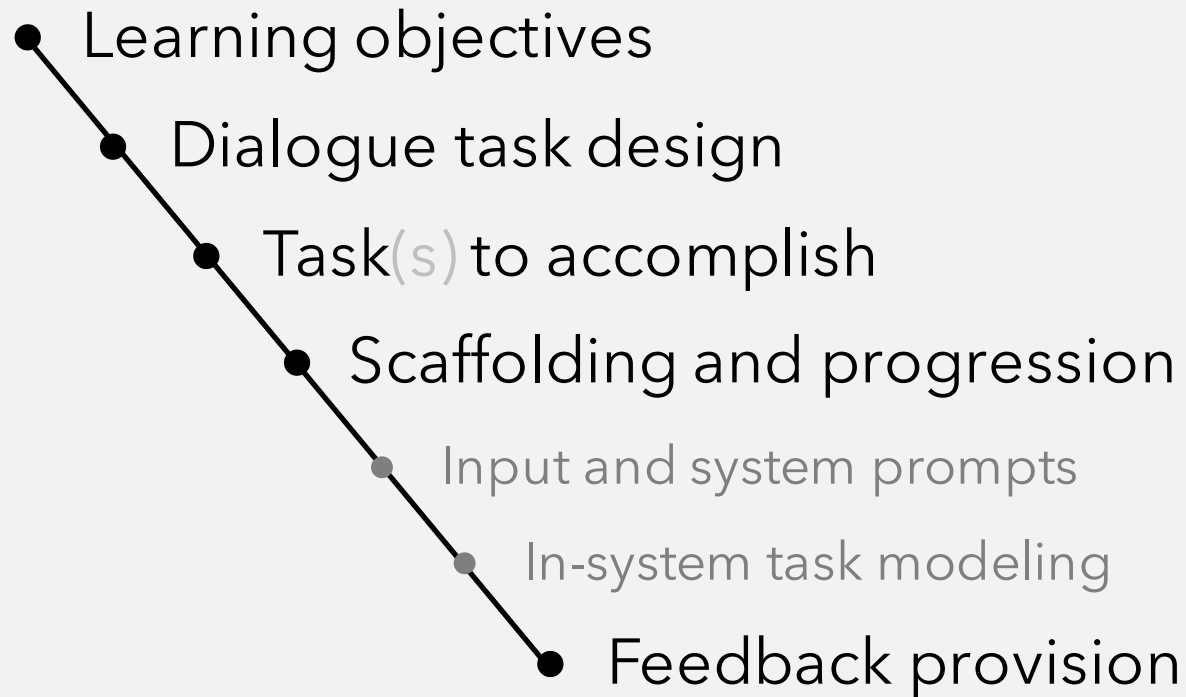
Available technology is not enough

“Free conversation” with an all-purpose “question answering” chatbot: ineffective, aimless, vapid.

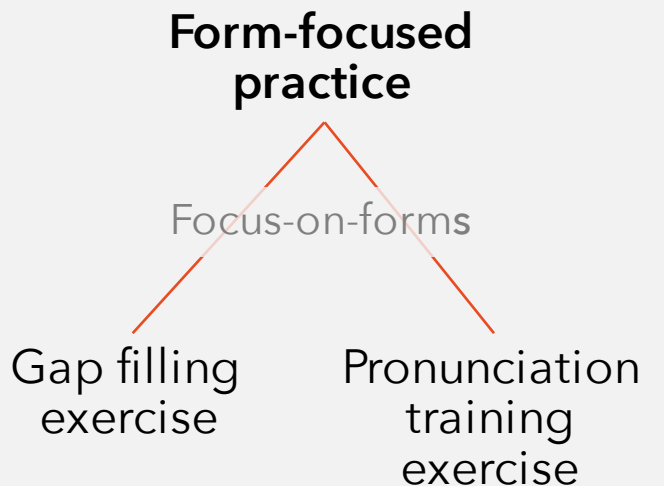
Various learning goals ⇔ various technologies

Bottom-up typology of dialogue-based CALL

# Instructional design framework for dialogue-based CALL



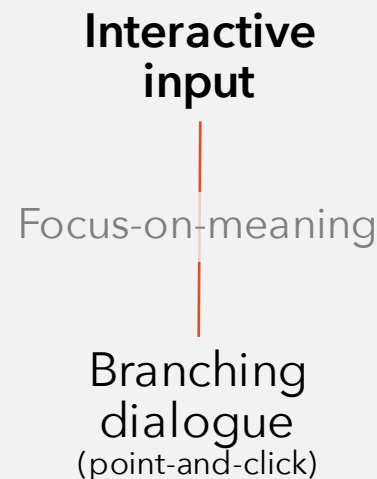
# Learning principles



Fixed path (script)

Talking to  
Avatars  
(Cerezo, 2010)

GenieTutor  
(Kwon et al, 2015)  
ARTUR  
(Engwall et al, 2014)  
FASOP  
(Cucchiarini et al, 2014)



Branching paths  
(fully predictable)

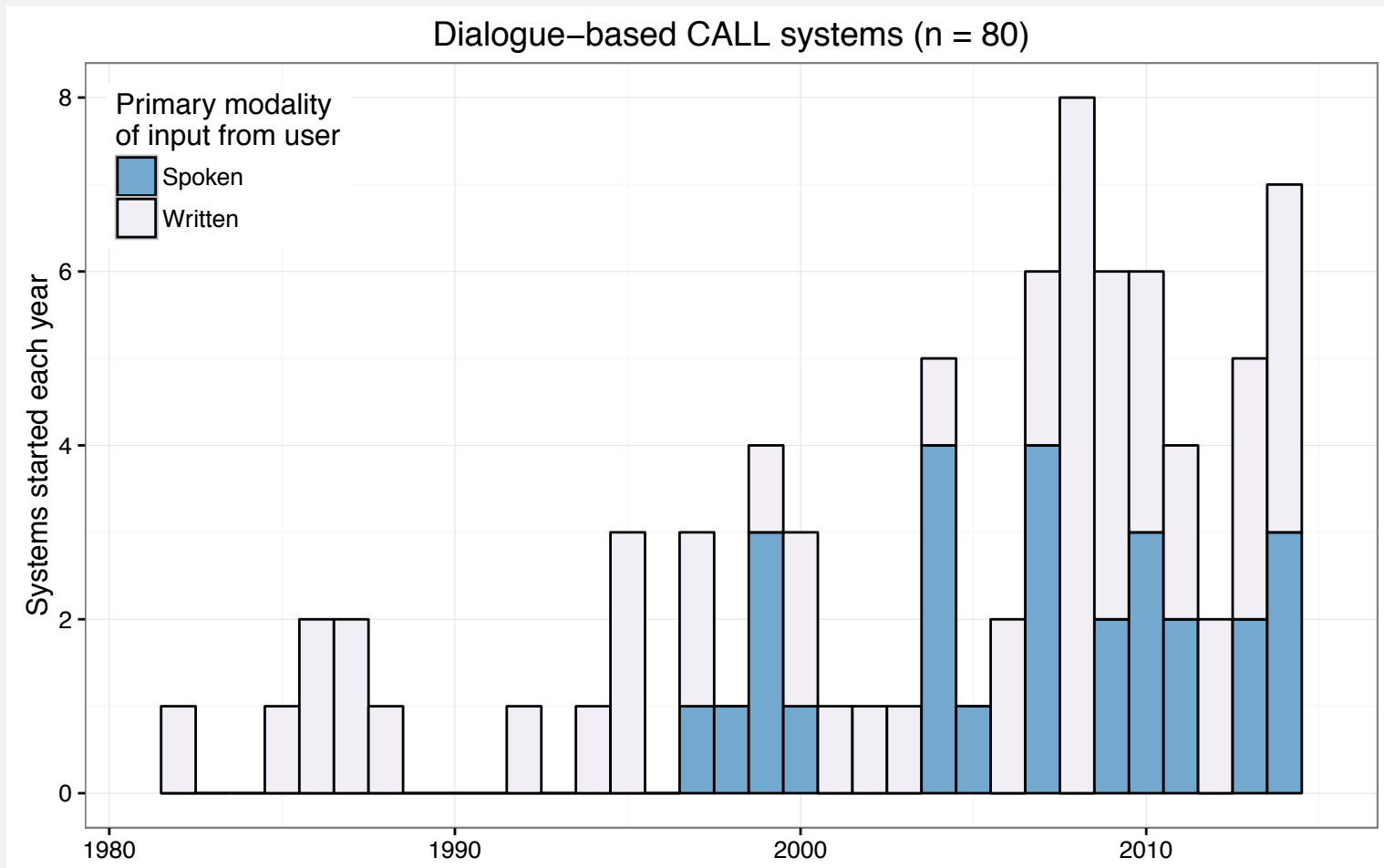
VILTS  
(Rypa & Price, 1999)  
Let's Chat  
(Stewart & File, 2007)  
Mentira  
(Holden & Sykes, 2011)



# Dialogue task design for interactive dialogue management

	User-initiated open-ended practice	Pre-scripted interaction	Interaction in fixed task	Interaction in multiple task
Goal-orientation	Open-ended	Goal	Goal	Goal
Initiative	User	System	Mixed	Mixed
Interactivity	High	Low	Medium	High
	↓	↓	↓	↓
Dialogue control	Pattern matching	Graph	Frame	Probabilistic control
Information extracted	Keywords	—	Entities	Intent + Entities
	Chatbots CSIEC (Jia, 2009)	Subarashii (Ehsani et al, 1997) Kaitito (Vlugter et al, 2009)	Let's Go (Raux et al, 2003) SPELL (Morton et al, 2011)	POMY (Lee et al, 2014)

# A short detour by Modalities (spoken vs. written)



# Spoken or written

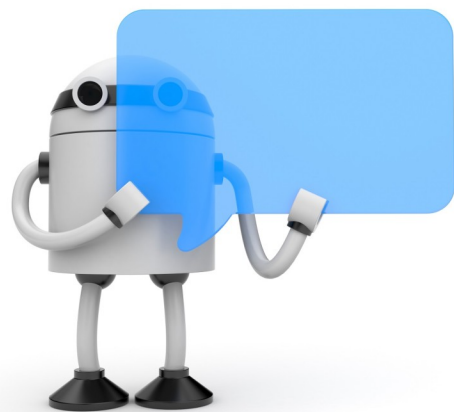
## Beyond the modality dichotomy

Not so much of an issue today.

Speech recognition<sup>(ASR)</sup> and  
speech synthesis<sup>(TTS)</sup> **as services**<sup>(SaaS)</sup>  
can be implemented into any system  
to enable speech capabilities

**Spontaneous** output vs. **prepared** output  
(synchronous, interactive) × (asynchronous, monologic)  
as a more relevant distinction, with  
major consequences on L2 acquisition

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# Dominant dialogue management paradigms and frameworks

Paradigm	Chatbot	Frame-based dialogue system	Deep learning	Probabilistic rules
Principle	Handcrafted rules	Handcrafted rules	Machine learning	Handcrafted rules + machine learn.
Dialogue control on	Normalized utterance	Slot-value pairs	Internal neural network representation	Intent & entities recognition
Frameworks	<b>ChatScript</b> <b>AIML</b> (see Pandorabots) <b>Rivescript</b>	<b>VoiceXML</b> <b>CSLU Toolkit</b> <b>CMU Olympus</b>	—  Note: requires extremely large corpus	<b>OpenDial</b> <b>Wit.ai BotEngine</b> <b>Api.ai</b> <b>Recast.ai</b> <b>IBM Watson</b> <b>Microsoft LUIS</b>
	1990s-2000s	1980s-2000s	2013-...	2014-...

# Why probabilistic approaches to dialogue management?

## Chatbots

Some systems with 250 000 rules!

And still dramatically limited, using massive avoidance strategies.

Deterministic rules cannot describe all cases.

Ambiguity pervades language.

Deep learning techniques have obtained good results, but require huge corpora

(Mesnil et al, 2013; Vinyals & Le, 2015; Shang et al, 2015)

Probabilistic rules offer the best of both worlds: statistical, data-driven techniques possible with small corpora

# Intent and entities recognition with Wit.ai Bot Engine

## Try out an expression

Test out and train how well your app can extract entities.

I would like to buy a medium-sized shirt

☒ intent

buy

☐

item

shirt

☐

wit/number

a

☐

size

medium



Add a new entity

# Dialogue-based CALL

## Summarizing

Need for **spontaneous interaction**

Previous research & systems

Scattered field, between ICALL,  
spoken dialogue systems and chatbots

Instructional design framework

Towards goal-oriented,  
mixed initiative interactions

NLP approaches to dialogue

From handcrafted rules to probabilistic rules  
for intent recognition and dialogue control



Thank **you** for **your attention**! Do you have **any** questions?



**addressee**

you

intent

ask-if-questions

intent

inquiry



**wit/quantity**

any



**reason**

your attention

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